FIG. 1

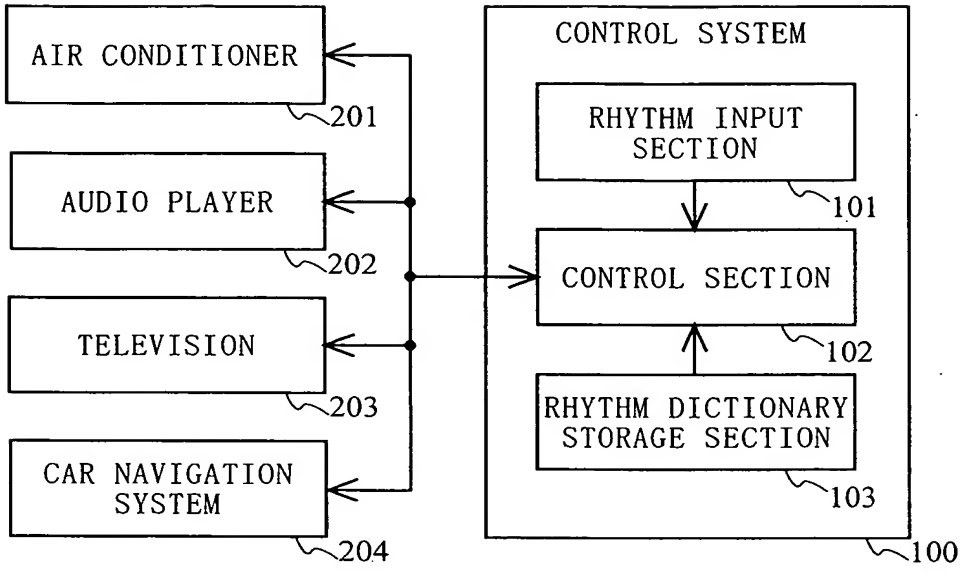

AIR CONDITIONER
201
AUDIO PLAYER
202
TELEVISION
203
CAR NAVIGATION SYSTEM
204
CONTROL SYSTEM
RHYTHM INPUT SECTION
101
CONTROL SECTION
102
RHYTHM DICTIONARY STORAGE SECTION
103
100

FIG. 2

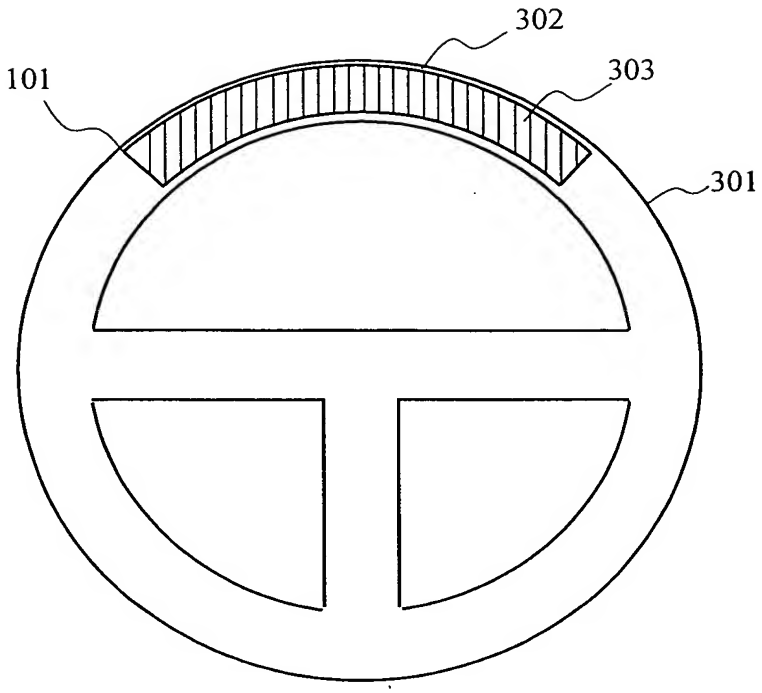

302
303
101
301

FIG. 3

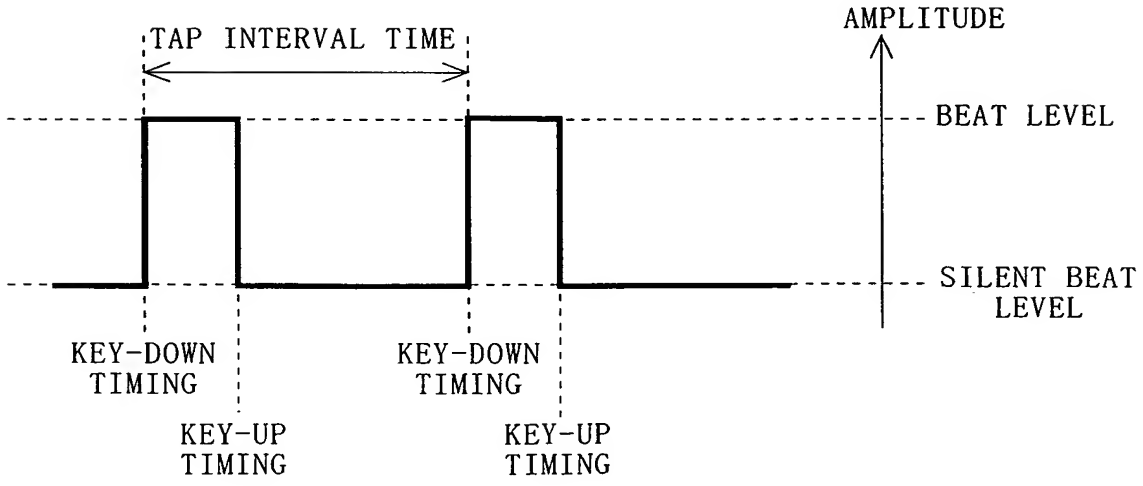

TAP INTERVAL TIME
AMPLITUDE
BEAT LEVEL
SILENT BEAT LEVEL
KEY-DOWN TIMING
KEY-UP TIMING
KEY-DOWN TIMING
KEY-UP TIMING

FIG. 4

MORA UNIT	UNIT RHYTHM PATTERN
SYLLABIC NASAL “ん(n)” (UNVOICED SOUND)	“_” (SILENT BEAT)
GEMINATE CONSONANT “っ(t)” (UNVOICED SOUND)	“_” (SILENT BEAT)
PALATAL CONSONANT “きゃ(kya)”, “きゅ(kyu)”, “きょ(kyo)”, ETC. (VOICED SOUND)	“x” (BEAT)
PROLONGED SOUND “あー(â)”, “けー(kê)”, ETC. (VOICED SOUND, UNVOICED SOUND)	“x–” (BEAT, SILENT BEAT)
DIPHTHONG “ああ(aa)”, “あい(ai)”, “えい(ei)”, ETC. (VOICED SOUND, UNVOICED SOUND)	“x–” (BEAT, SILENT BEAT)
GENERAL SOUND	“x” (BEAT)

FIG. 5

NAME OF CONTENTS OF CONTROL	REGISTERED RHYTHM PATTERN
地図(chizu)	x x
電話(denwa)	x − x
エアコン(eakon)	x x x
温度設定(ondosettê)	x − x x − x
オーディオ(ôdhio)	x − x x
・・・	・・・

FIG. 6

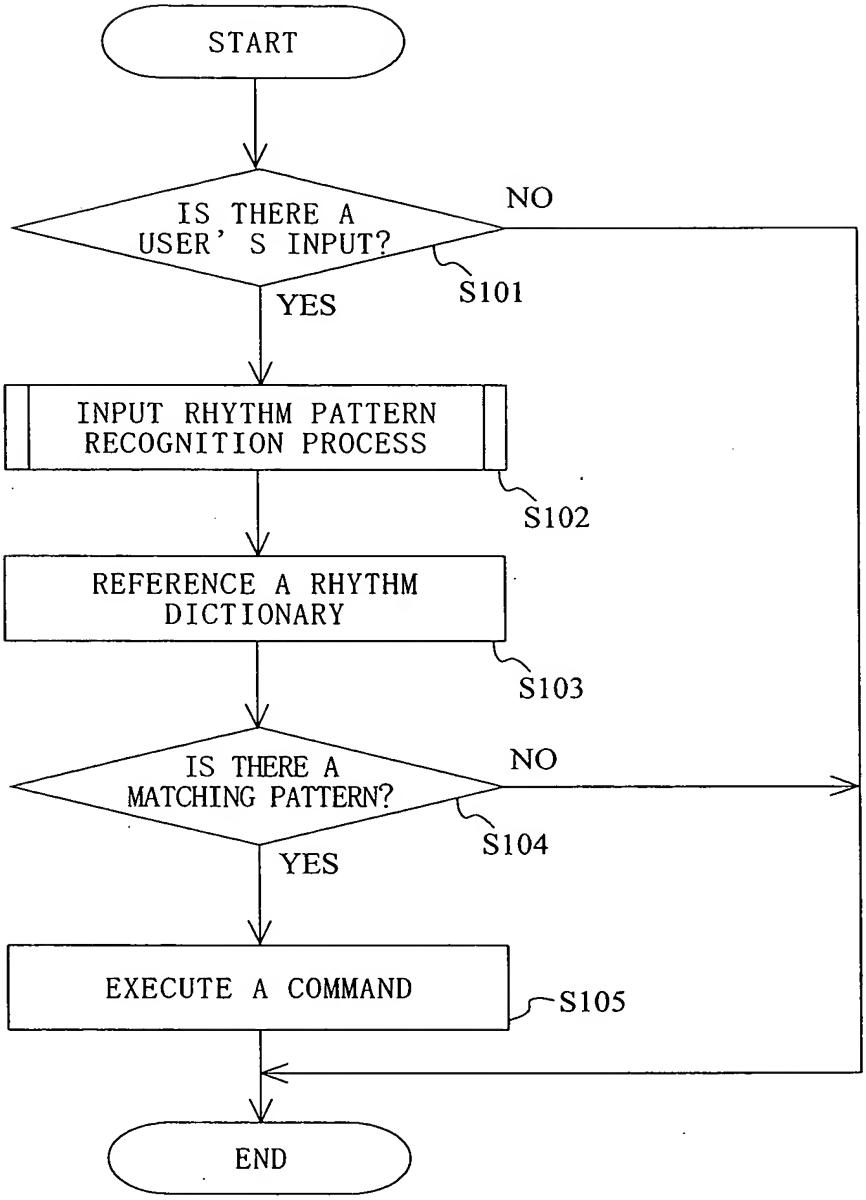

START
IS THERE A USER' S INPUT?
NO
S101
YES
INPUT RHYTHM PATTERN RECOGNITION PROCESS
S102
REFERENCE A RHYTHM DICTIONARY
S103
IS THERE A MATCHING PATTERN?
NO
S104
YES
EXECUTE A COMMAND
S105
END

FIG. 7

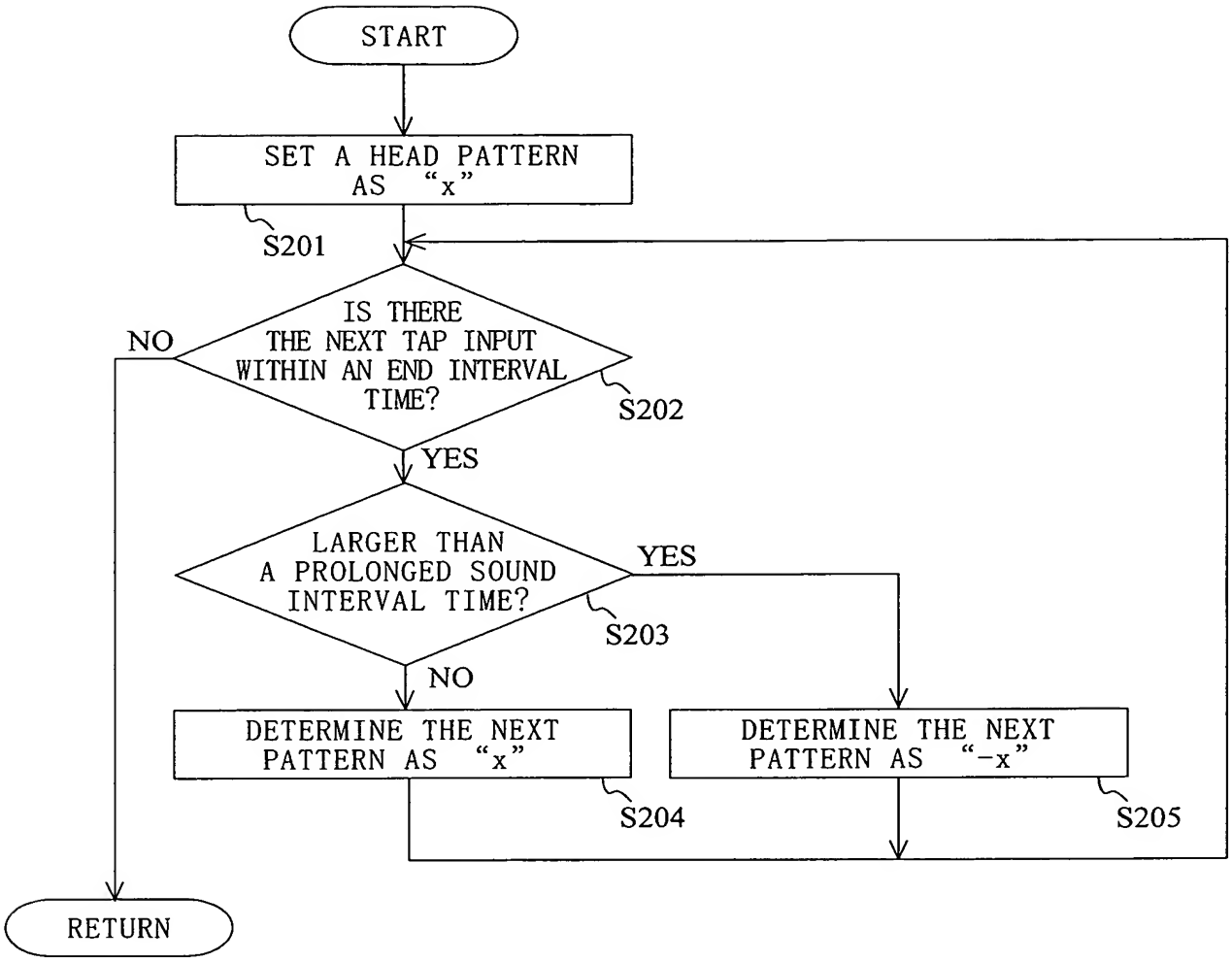

START
SET A HEAD PATTERN AS "x"
S201
IS THERE THE NEXT TAP INPUT WITHIN AN END INTERVAL TIME?
S202
NO
YES
LARGER THAN A PROLONGED SOUND INTERVAL TIME?
S203
YES
NO
DETERMINE THE NEXT PATTERN AS "x"
S204
DETERMINE THE NEXT PATTERN AS "-x"
S205
RETURN

FIG. 8

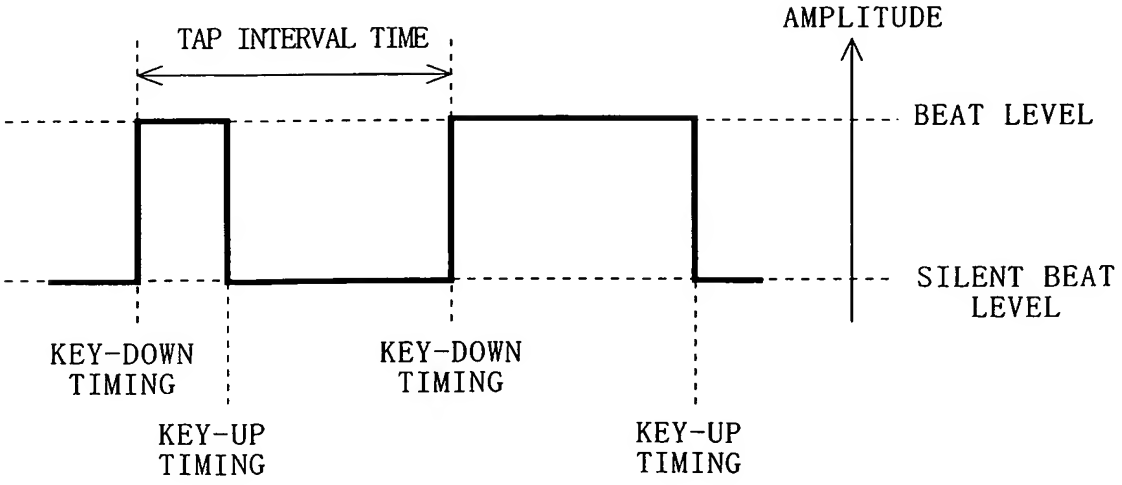

TAP INTERVAL TIME
AMPLITUDE
BEAT LEVEL
SILENT BEAT LEVEL
KEY-DOWN TIMING
KEY-UP TIMING
KEY-DOWN TIMING
KEY-UP TIMING

FIG. 9

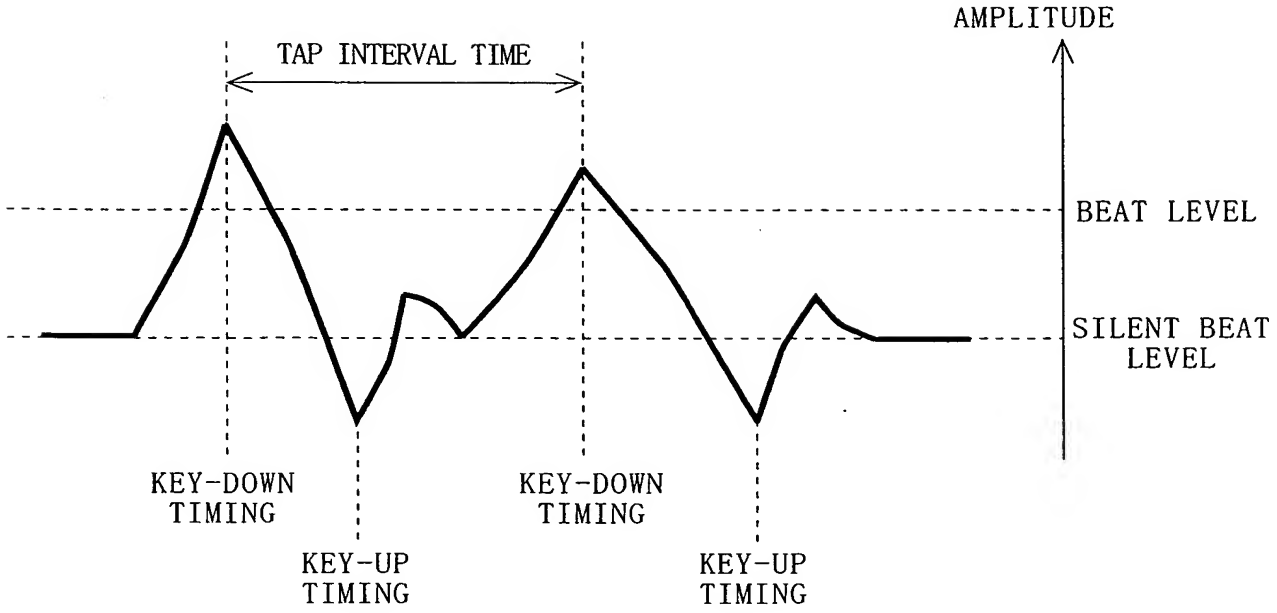

AMPLITUDE
TAP INTERVAL TIME
BEAT LEVEL
SILENT BEAT LEVEL
KEY-DOWN TIMING
KEY-DOWN TIMING
KEY-UP TIMING
KEY-UP TIMING

FIG. 10

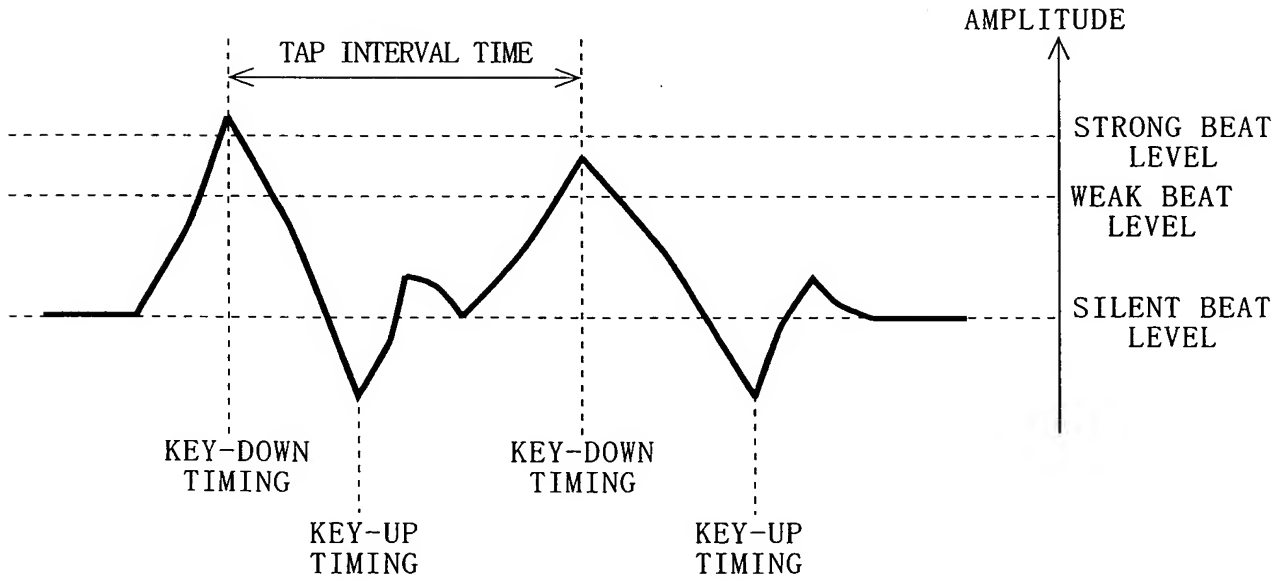

AMPLITUDE
TAP INTERVAL TIME
STRONG BEAT LEVEL
WEAK BEAT LEVEL
SILENT BEAT LEVEL
KEY-DOWN TIMING
KEY-DOWN TIMING
KEY-UP TIMING
KEY-UP TIMING

FIG. 11

SYLLABIC UNIT	UNIT RHYTHM PATTERN
ACCENTED SYLLABLE (VOICED SOUND)	"A" (STRONG BEAT)
UNACCENTED SYLLABLE (VOICED SOUND)	"x" (WEAK BEAT)
ACCENTED PROLONGED SYLLABLE (VOICED SOUND, UNVOICED SOUND)	"A–" (STRONG BEAT, SILENT BEAT)
UNACCENTED PROLONGED SYLLABLE (VOICED SOUND, UNVOICED SOUND)	"x–" (WEAK BEAT, SILENT BEAT)
ACCENTED DIPHTHONG (VOICED SOUND, UNVOICED SOUND)	"A–" (STRONG BEAT, SILENT BEAT)
UNACCENTED DIPHTHONG (VOICED SOUND, UNVOICED SOUND)	"x–" (WEAK BEAT, SILENT BEAT)

FIG. 12

NAME OF CONTENTS OF CONTROL	REGISTERED RHYTHM PATTERN
Navigation	x x A − x
Telephone	A x x
Air conditioner	A − x A x x
Temperature	A − x x x
Audio	A − x x
. . .	. . .

FIG. 13

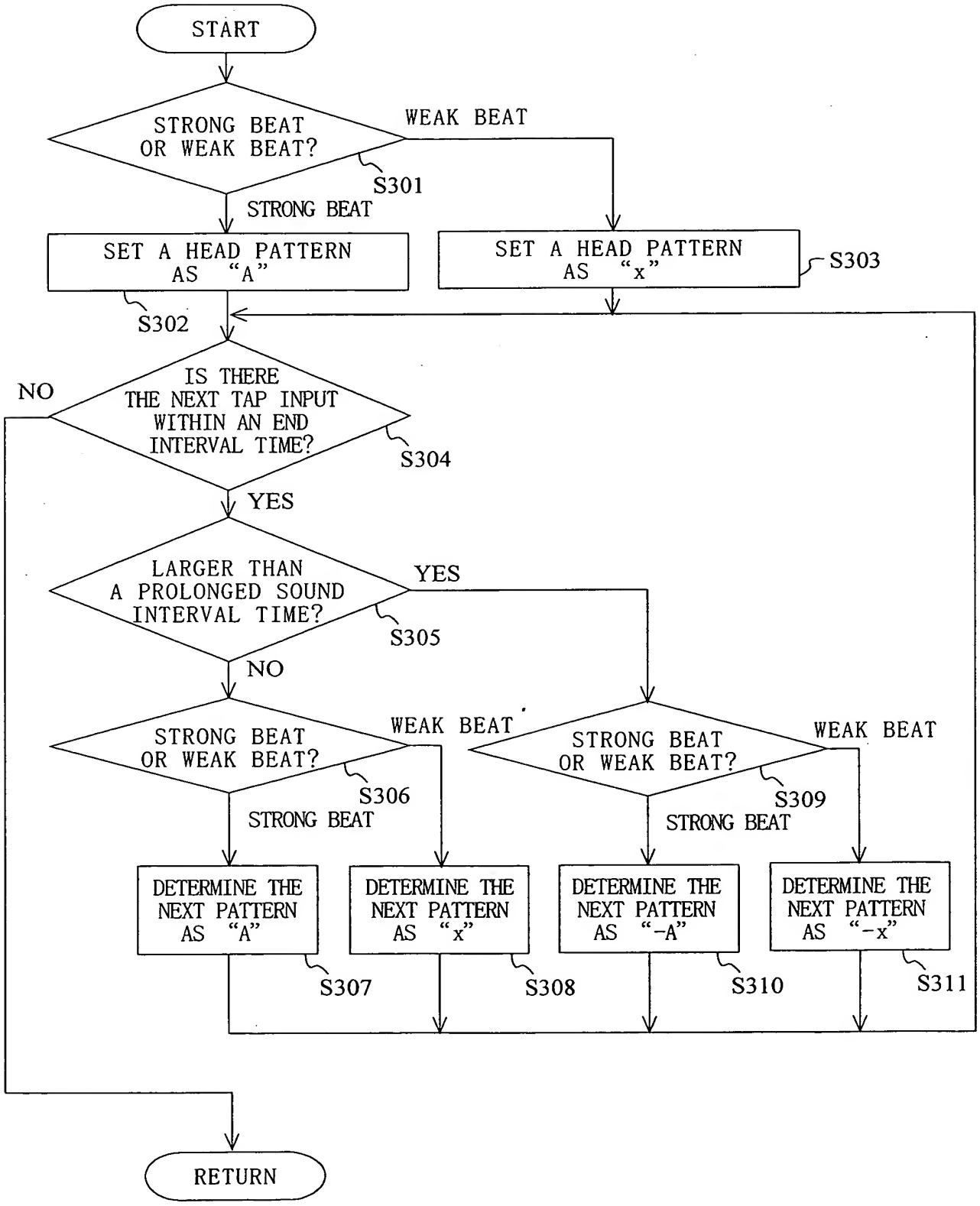

START
STRONG BEAT OR WEAK BEAT?
S301
WEAK BEAT
STRONG BEAT
SET A HEAD PATTERN AS "A"
S302
SET A HEAD PATTERN AS "x"
S303
IS THERE THE NEXT TAP INPUT WITHIN AN END INTERVAL TIME?
S304
NO
YES
LARGER THAN A PROLONGED SOUND INTERVAL TIME?
S305
YES
NO
STRONG BEAT OR WEAK BEAT?
S306
WEAK BEAT
STRONG BEAT
STRONG BEAT OR WEAK BEAT?
S309
WEAK BEAT
STRONG BEAT
DETERMINE THE NEXT PATTERN AS "A"
S307
DETERMINE THE NEXT PATTERN AS "x"
S308
DETERMINE THE NEXT PATTERN AS "-A"
S310
DETERMINE THE NEXT PATTERN AS "-x"
S311
RETURN

FIG. 14

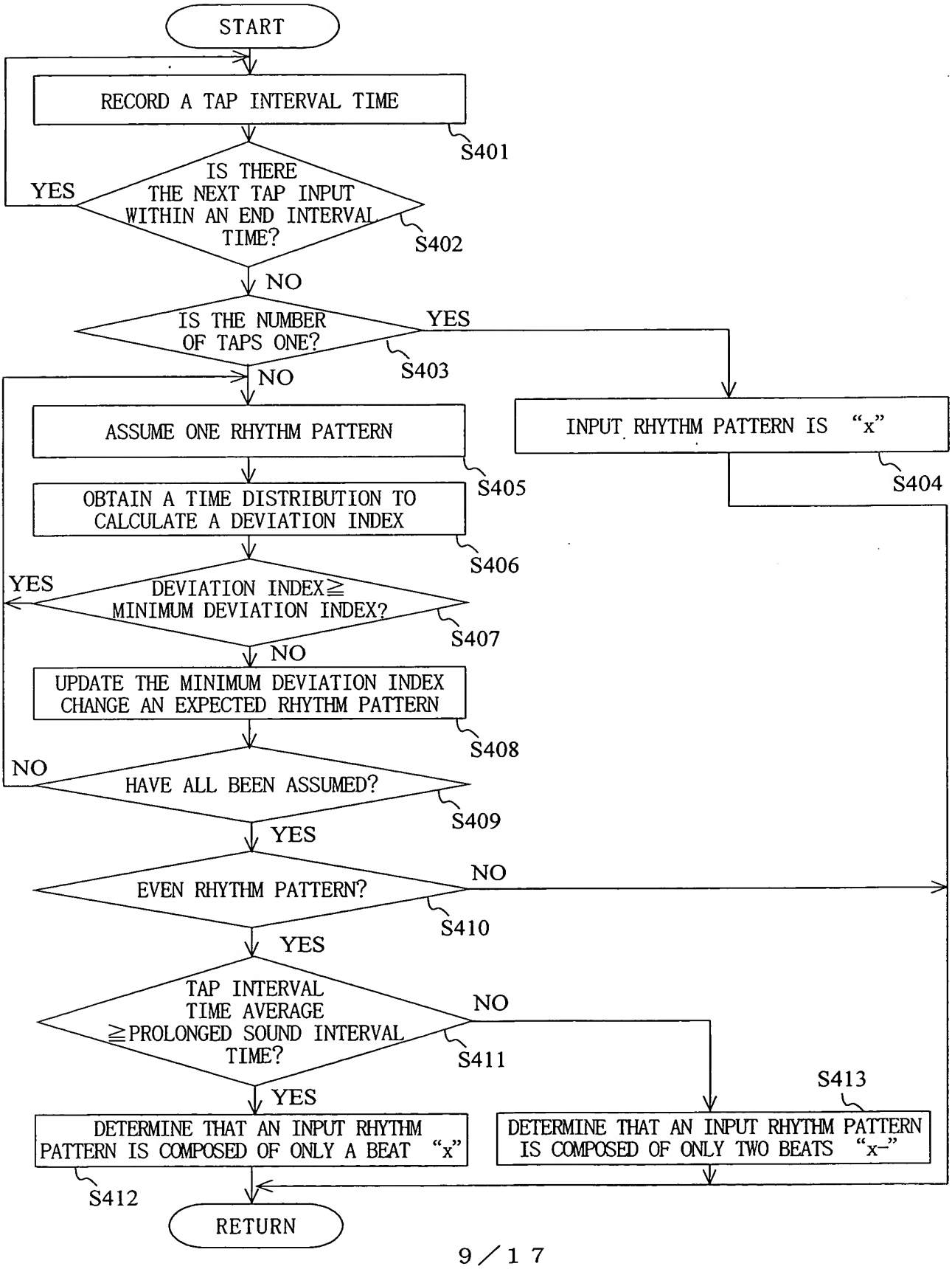

START
RECORD A TAP INTERVAL TIME
S401
IS THERE THE NEXT TAP INPUT WITHIN AN END INTERVAL TIME?
YES
S402
NO
IS THE NUMBER OF TAPS ONE?
YES
S403
NO
ASSUME ONE RHYTHM PATTERN
S405
INPUT RHYTHM PATTERN IS "x"
S404
OBTAIN A TIME DISTRIBUTION TO CALCULATE A DEVIATION INDEX
S406
DEVIATION INDEX≧ MINIMUM DEVIATION INDEX?
YES
S407
NO
UPDATE THE MINIMUM DEVIATION INDEX CHANGE AN EXPECTED RHYTHM PATTERN
S408
HAVE ALL BEEN ASSUMED?
NO
S409
YES
EVEN RHYTHM PATTERN?
NO
S410
YES
TAP INTERVAL TIME AVERAGE ≧PROLONGED SOUND INTERVAL TIME?
NO
S411
YES
S413
DETERMINE THAT AN INPUT RHYTHM PATTERN IS COMPOSED OF ONLY A BEAT "x"
S412
DETERMINE THAT AN INPUT RHYTHM PATTERN IS COMPOSED OF ONLY TWO BEATS "x-"
RETURN

FIG. 15

TAP NUMBER	ACTUAL TAP INTERVAL TIME Ti (ms)
1	764
2	311
3	684
4	341
5	
TOTAL	Σ Ti=2,100
AVERAGE	525

FIG. 16

TAP NUMBER	ASSUMED TAP RHYTHM PATTERN	NUMBER OF BEATS λ i	ASSUMED TAP INTERVAL TIME (ms)	DEVIATION (ms)
1	x —	2	700	+64
2	x	1	350	−39
3	x	1	350	+334
4	x —	2	700	−359
5	x			
TOTAL		Σ λi=6	2, 100	0
AVERAGE		1. 5	τ=350	σ=199

FIG. 17

TAP NUMBER	ASSUMED TAP RHYTHM PATTERN	NUMBER OF BEATS λ i	ASSUMED TAP INTERVAL TIME (ms)	DEVIATION (ms)
1	x —	2	700	+64
2	x	1	350	−39
3	x —	2	700	−16
4	x	1	350	−9
5	x			
TOTAL		Σ λi=6	2, 100	0
AVERAGE		1. 5	τ=350	σ=32

FIG. 18

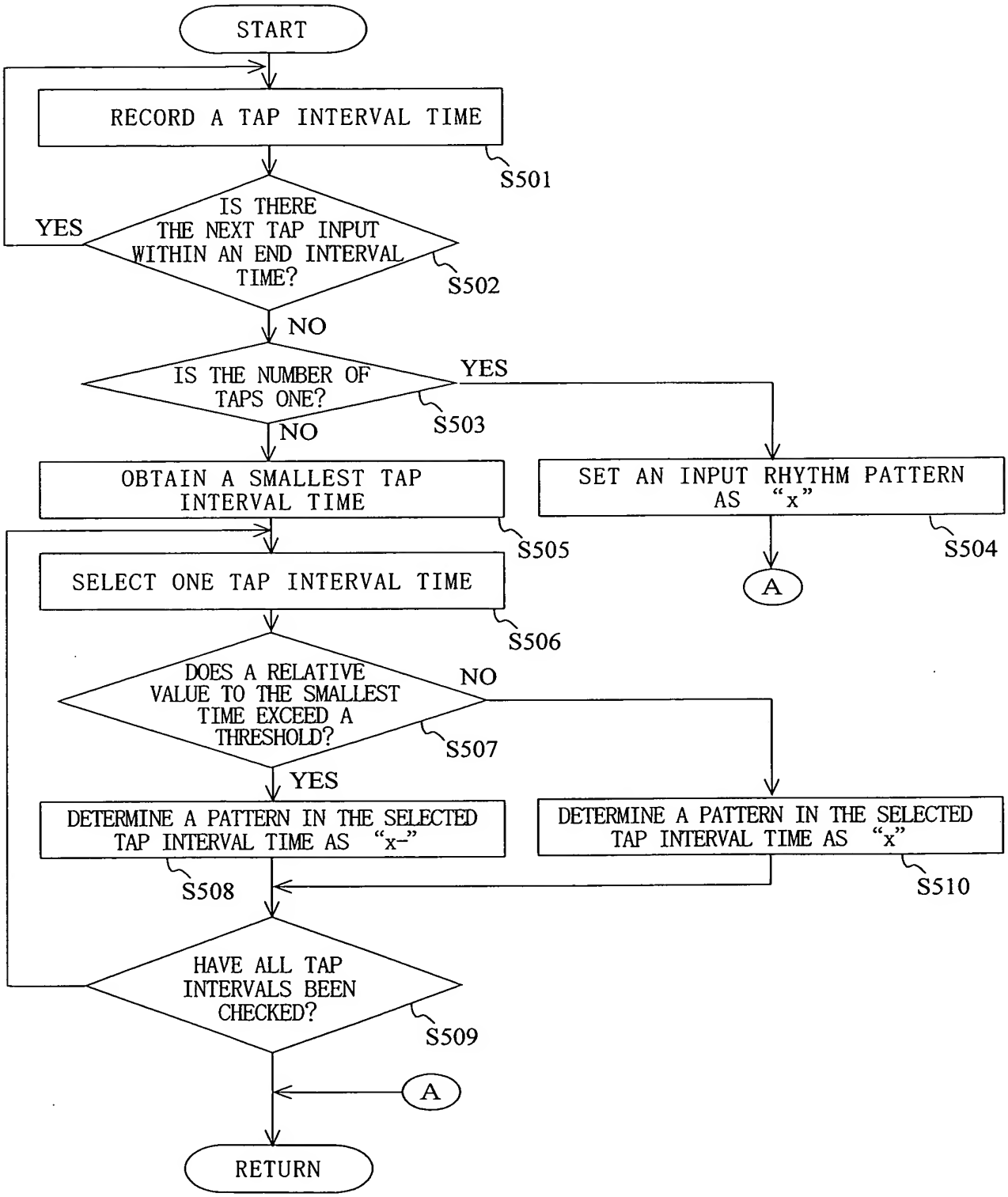

START
RECORD A TAP INTERVAL TIME
S501
IS THERE THE NEXT TAP INPUT WITHIN AN END INTERVAL TIME?
YES
S502
NO
IS THE NUMBER OF TAPS ONE?
YES
S503
NO
OBTAIN A SMALLEST TAP INTERVAL TIME
S505
SET AN INPUT RHYTHM PATTERN AS "x"
S504
A
SELECT ONE TAP INTERVAL TIME
S506
DOES A RELATIVE VALUE TO THE SMALLEST TIME EXCEED A THRESHOLD?
NO
S507
YES
DETERMINE A PATTERN IN THE SELECTED TAP INTERVAL TIME AS "x-"
S508
DETERMINE A PATTERN IN THE SELECTED TAP INTERVAL TIME AS "x"
S510
HAVE ALL TAP INTERVALS BEEN CHECKED?
S509
A
RETURN

FIG. 19

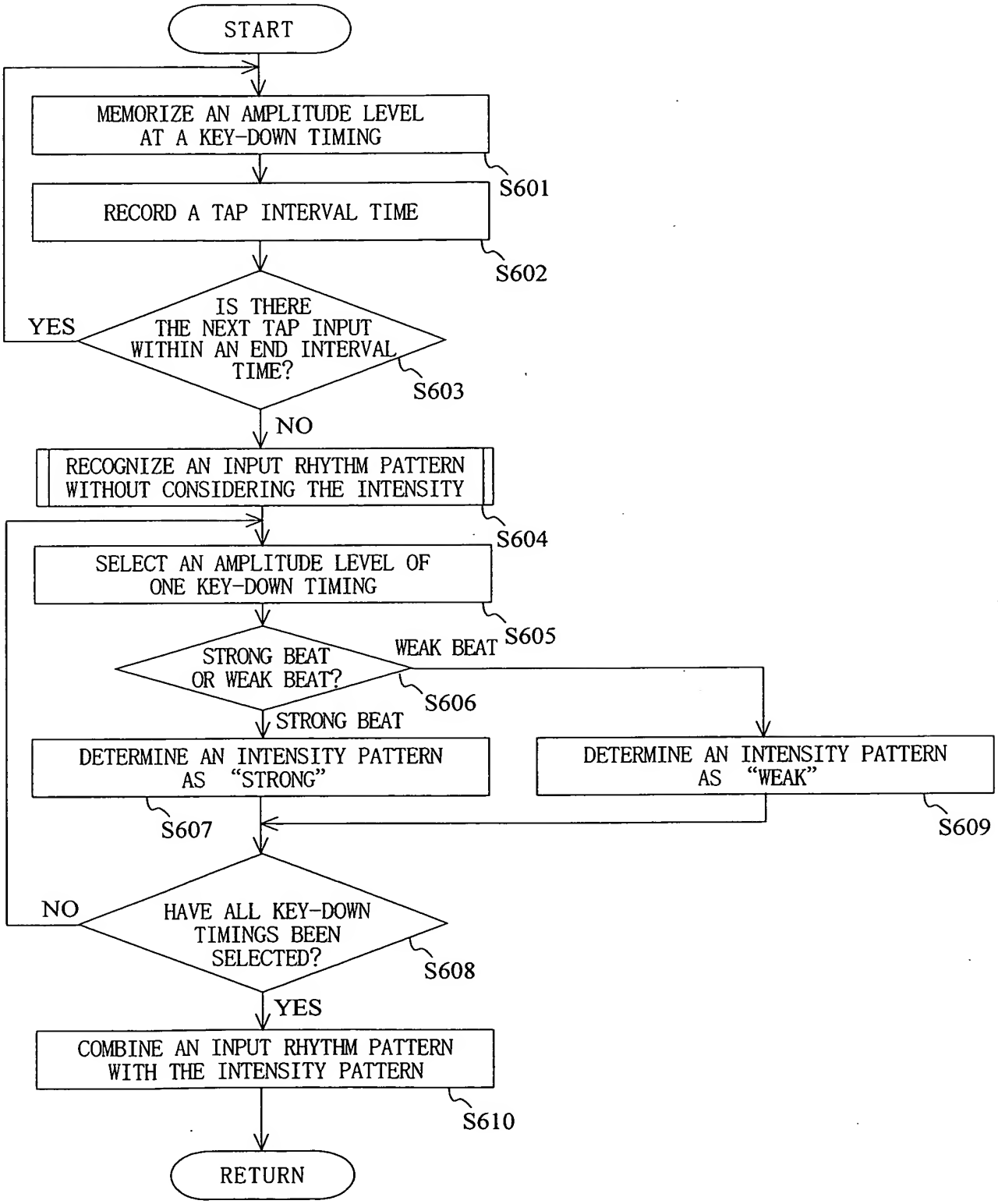

START
MEMORIZE AN AMPLITUDE LEVEL AT A KEY-DOWN TIMING
S601
RECORD A TAP INTERVAL TIME
S602
IS THERE THE NEXT TAP INPUT WITHIN AN END INTERVAL TIME?
YES
S603
NO
RECOGNIZE AN INPUT RHYTHM PATTERN WITHOUT CONSIDERING THE INTENSITY
S604
SELECT AN AMPLITUDE LEVEL OF ONE KEY-DOWN TIMING
S605
STRONG BEAT OR WEAK BEAT?
WEAK BEAT
S606
STRONG BEAT
DETERMINE AN INTENSITY PATTERN AS "STRONG"
S607
DETERMINE AN INTENSITY PATTERN AS "WEAK"
S609
HAVE ALL KEY-DOWN TIMINGS BEEN SELECTED?
NO
S608
YES
COMBINE AN INPUT RHYTHM PATTERN WITH THE INTENSITY PATTERN
S610
RETURN

FIG. 20

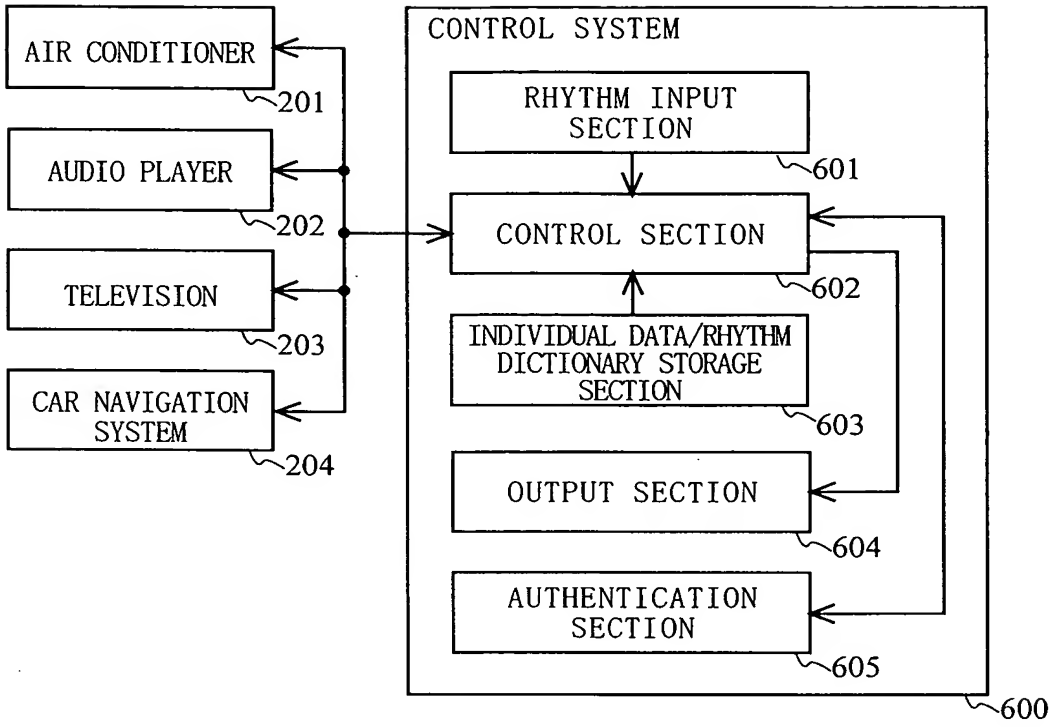

AIR CONDITIONER
201
AUDIO PLAYER
202
TELEVISION
203
CAR NAVIGATION SYSTEM
204
CONTROL SYSTEM
RHYTHM INPUT SECTION
601
CONTROL SECTION
602
INDIVIDUAL DATA/RHYTHM DICTIONARY STORAGE SECTION
603
OUTPUT SECTION
604
AUTHENTICATION SECTION
605
600

FIG. 21

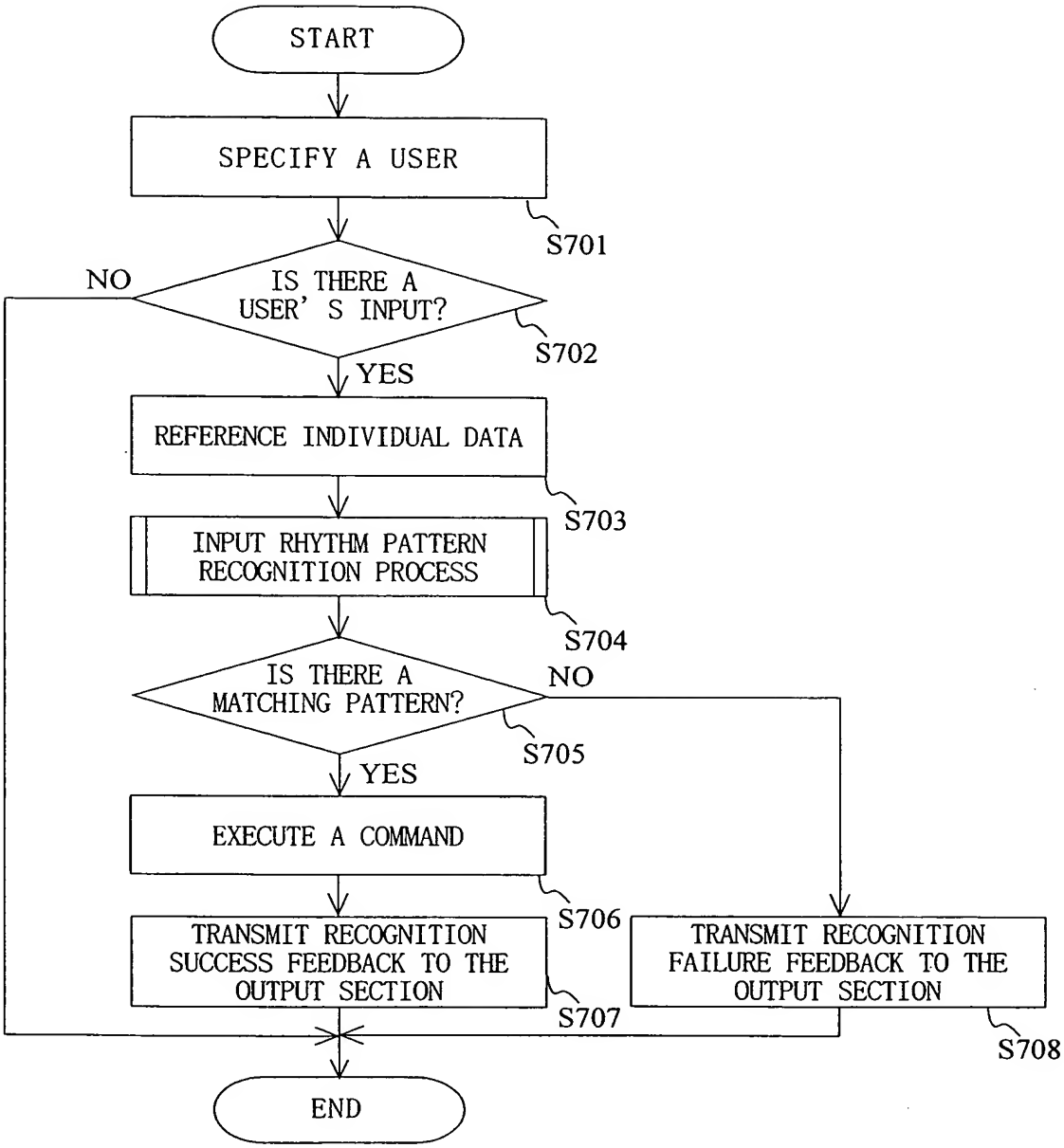

START
SPECIFY A USER
S701
IS THERE A USER' S INPUT?
NO
S702
YES
REFERENCE INDIVIDUAL DATA
S703
INPUT RHYTHM PATTERN RECOGNITION PROCESS
S704
IS THERE A MATCHING PATTERN?
NO
S705
YES
EXECUTE A COMMAND
S706
TRANSMIT RECOGNITION SUCCESS FEEDBACK TO THE OUTPUT SECTION
S707
TRANSMIT RECOGNITION FAILURE FEEDBACK TO THE OUTPUT SECTION
S708
END

FIG. 22

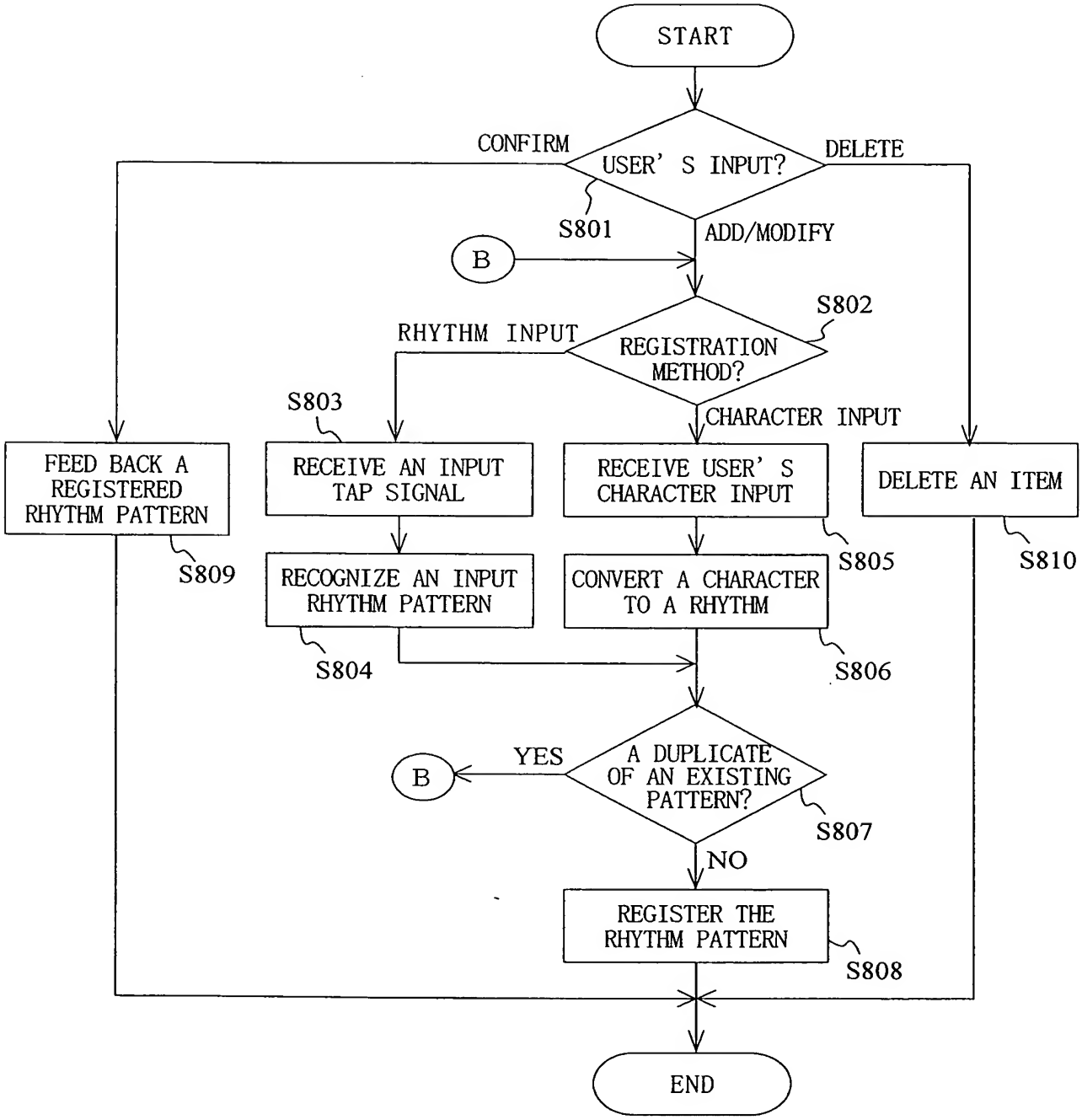

START
USER' S INPUT?
CONFIRM
DELETE
S801
ADD/MODIFY
B
S802
REGISTRATION METHOD?
RHYTHM INPUT
CHARACTER INPUT
S803
FEED BACK A REGISTERED RHYTHM PATTERN
RECEIVE AN INPUT TAP SIGNAL
RECEIVE USER' S CHARACTER INPUT
DELETE AN ITEM
S809
S805
S810
RECOGNIZE AN INPUT RHYTHM PATTERN
CONVERT A CHARACTER TO A RHYTHM
S804
S806
A DUPLICATE OF AN EXISTING PATTERN?
YES
B
S807
NO
REGISTER THE RHYTHM PATTERN
S808
END

FIG. 23

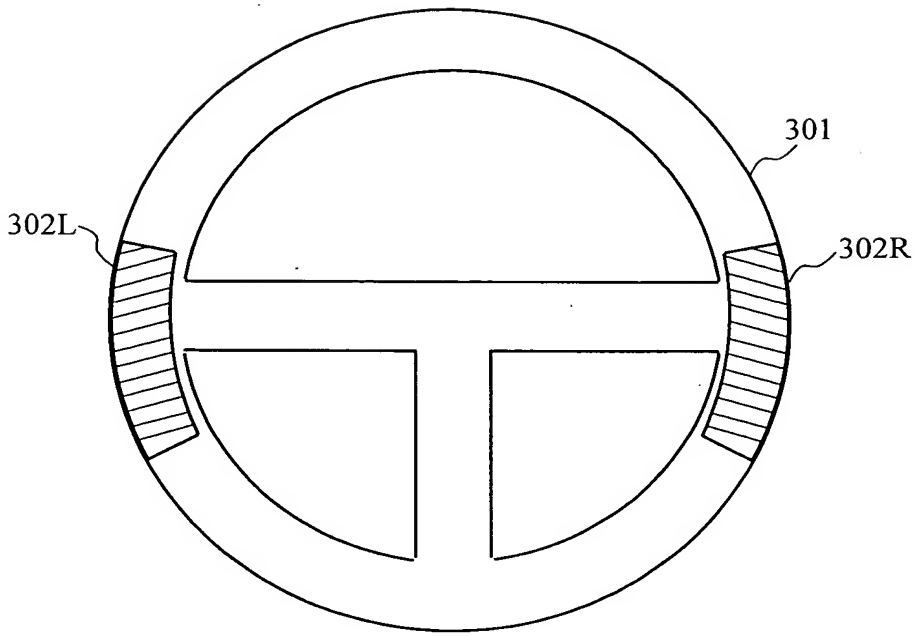
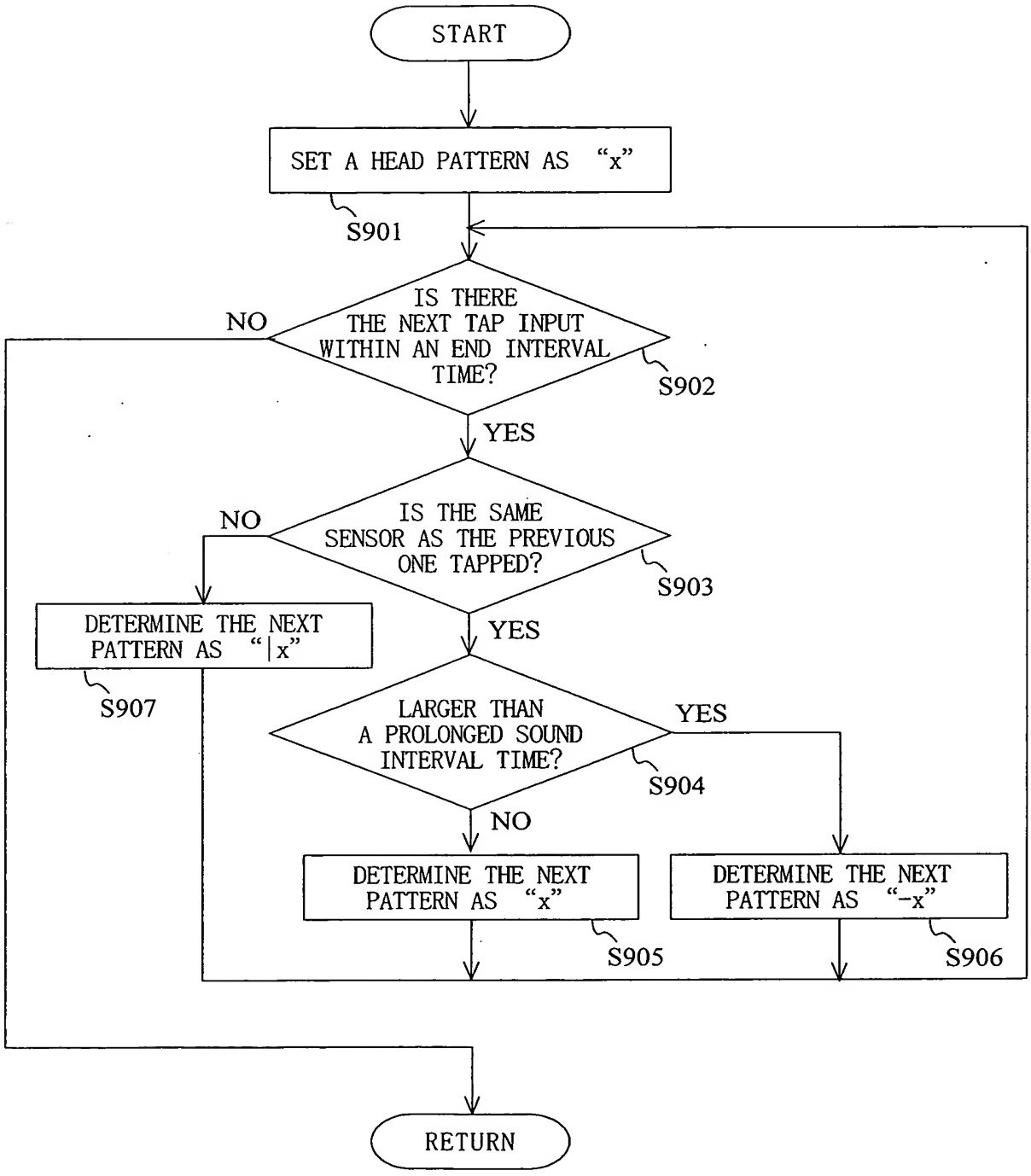


FIG. 24

LARGE FUNCTION (LEFT-HAND SWITCH)	REGISTERED RHYTHM PATTERN	SMALL FUNCTION (RIGHT-HAND SWITCH)	REGISTERED RHYTHM PATTERN
FM(efuemu)	x x x x	大阪(ô saka)	x − x x
		８０２(hachimaruni)	x x x x x
		ＮＨＫ(enueichikei)	x x x − x x
経路探索 (keirotansaku)	x − x x − x x	自宅(jitaku)	x x x
		会社(kaisha)	x − x
		遊園地(y û enchi)	x − x − x
		大阪駅(ô sakaeki)	x − x x x x
イコライザー (ikoraiza)	x x x x x	クラッシック(kurashikku)	x x x − x
		ロック(rokku)	x − x
		ジャズ(jyazu)	x x
		フラット(furatto)	x x − x

FIG. 25


START
SET A HEAD PATTERN AS "x"
S901
IS THERE THE NEXT TAP INPUT WITHIN AN END INTERVAL TIME?
NO
S902
YES
IS THE SAME SENSOR AS THE PREVIOUS ONE TAPPED?
NO
S903
YES
DETERMINE THE NEXT PATTERN AS "|x"
S907
LARGER THAN A PROLONGED SOUND INTERVAL TIME?
YES
S904
NO
DETERMINE THE NEXT PATTERN AS "x"
S905
DETERMINE THE NEXT PATTERN AS "-x"
S906
RETURN